# PATENT ABSTRACTS OF JAPAN

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OGASAWARA MAMORU
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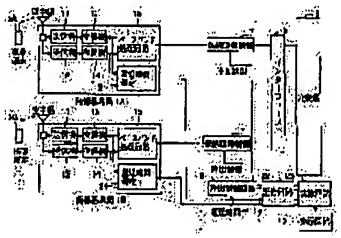
## (54) PORTABLE TERMINAL POSITION DETECTING METHOD OF MICRO CELL MOBILE COMMUNICATION SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To detect in which zone (cell) a portable terminal is located with high precision.
SOLUTION: A calling control part 8 successively calls to a portable terminal through entire radio stations 1A and 1B, each base station 1A and 1B measures the delay time from transmission of a calling signal till the reception of a response signal from a portable terminal and sends existence of response of each portable terminal and measured delay time to the part 8, and the part 8 decides that the portable terminal is located in a radio zone of a radio base station whose measured delay time is the shortest when plural responses exist to one portable terminal.



LEGAL STATUS

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[Date of sending the examiner's decision of rejection]
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[Patent number] 3379079
[Date of registration] 13.12.2002
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[Date of extinction of right]

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## CLAIMS

[Claim(s)]
[Claim 1] Divide into two or more wireless zones, overlapping a part of service field, and the base transceiver station prepared for every wireless zone of that, respectively is led. In the microcell migration communication mode which was made to perform transmission and reception of the personal digital assistant which exists in the wireless zone, and a wireless electric wave Two or more above-mentioned base transceiver stations are led from a call control section. A personal digital assistant A sequential call, It is the approach of detecting the response personal digital assistant being located in the wireless zone of the base transceiver station where the response was received. Each above-mentioned base transceiver station measures the time delay of the reply signal from the above-mentioned personal digital assistant to the above-mentioned alerting signal. When the measurement delay time is notified to the above-mentioned call control section and it is received in the base transceiver station of plurality [ control section / above-mentioned / call / response / from the same personal digital assistant ] The personal digital assistant location detection approach of the microcell migration communication mode characterized by judging with the personal digital assistant being located in the wireless zone of the minimum base transceiver station of the measurement delay time.
[Claim 2] Divide into two or more wireless zones, overlapping a part of service field, and the base transceiver station prepared for every wireless zone of that, respectively is led. In the microcell migration communication mode which was made to perform transmission and reception of the personal digital assistant which exists in the wireless zone, and a wireless electric wave Two or more above-mentioned base transceiver stations are led from a call control section. A personal digital assistant A sequential call, It is the approach of detecting the response personal digital assistant being located in the wireless zone of the base transceiver station where the response was received. The centralized-control section sent and received to each above-mentioned base transceiver station near the above-mentioned call control section is concentrated and prepared. Perform the call of a personal digital assistant for each base transceiver station through the above-mentioned centralized-control section, and the time delay of the reply signal from the above-mentioned personal digital assistant to the above-mentioned alerting signal is measured in each above-mentioned centralized-control section. When the measuring time is notified to the above-mentioned call control section and it is received in the base transceiver station of plurality [ control section / above-mentioned / call / response / from the same personal digital assistant ] The personal digital assistant location detection approach of the microcell migration communication mode characterized by judging with the personal digital assistant being located in the wireless zone of the minimum base transceiver station of the measurement delay time.

[Translation done.]



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## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the approach of detecting the location of the personal digital assistant in the mobile communication of microcell radio system.
[0002]
[Description of the Prior Art] Drawing 5 shows the structure of a system which performs the conventional method of detecting the location of a personal digital assistant in the migration communication system which used microcell radio system. In order for a microcell method to be a method which repeats the same frequency and uses a wireless zone (cel) radius as about several 100m for a frequency deployment and for a base transceiver station to carry out a line connection to a personal digital assistant, the distance with a personal digital assistant needs to be less than about several 100m, and when a personal digital assistant comes out of a wireless zone (cel), it must connect using the base transceiver station of a migration place wireless zone (cel). For this reason, the location of a personal digital assistant is detectable by getting to know the installation location of the base transceiver station connected by carrying out a line connection to a personal digital assistant.
[0003] In drawing 5 , base transceiver station 1A performs the communication link between personal digital assistant 3A located in self-wireless zone 2A, and performs transmission and reception of voice data and control data by transmitting and receiving a wireless electric wave. The interface circuitry 5 in a contact 4 makes connection between a public network 6 and the wireless line control circuit 7, and a public network 6 is connected with a personal digital assistant 3 by the call origination from a personal digital assistant 3, the wireless line control circuit 7 calls a personal digital assistant 3 by the call in from a public network 6, and it connects it. When a personal digital assistant 3 is called, an electric wave reaches a personal digital assistant 3 and the call control circuit 8 has a response by using two or more base transceiver station 1A and 1B— one by one every fixed time amount, it detects that a personal digital assistant 3 is located in the wireless zone 2 of the receiving base transceiver station 1. Memorizing this relation to a store circuit 9, a store circuit 9 carries out number management of two or more base transceiver station and two or more personal digital assistants, and memorizes a base transceiver station number connectable with a personal digital assistant. The wireless zone in which a personal digital assistant is located is displayed on a display circuit 10.
[0004] By drawing 5 , personal digital assistant 3A is located in wireless zone 2of base transceiver station 1A A, base transceiver station 1A is the distance which can be talked over the telephone, and base transceiver station 1B shows the case where a message is impossible. When base transceiver station 1A to personal digital assistant 3A is called and there is a response from personal digital assistant 3A, a store circuit 9 memorizes that personal digital assistant 3A is located in wireless zone (microcell) 2A in which base transceiver station 1A can connect with personal digital assistant 3A, and base transceiver station 1A is located. Next, when base transceiver station 1B to personal digital assistant 3A is called and there is no response, it memorizes that base transceiver station 1B was not able to connect the store circuit 9 with personal digital assistant 3A.

[0005] Next, personal digital assistant 3AB in drawing 5 is the case where it is located in base transceiver station 1A and both wireless zone 2A of base transceiver station 1B, and 2B, and base transceiver station 1A and base transceiver station 1B are located in personal digital assistant 3AB at the distance which can be talked over the telephone. In this case, it memorizes that base transceiver station 1A and base transceiver station 1B have connected the store circuit 9 to personal digital assistant 3AB. Therefore, since whether it is close to which being located in one of the wireless zones of base transceiver station 1A and base transceiver station 1B although it is detectable was not able to specify personal digital assistant 3AB, exact location detection was not able to do it.

[0006]

[Problem(s) to be Solved by the Invention] In order to lose the blind zone of an electric wave, when the reception input of a personal digital assistant becomes weak around the wireless zone distant from the base transceiver station by making a wireless zone overlap and a line connection with a base transceiver station becomes impossible, it enables it to have connected with other base transceiver stations with microcell radio system generally. With the configuration of drawing 5 , since personal digital assistant 3AB is moving to the mid-position of wireless zone 2A and 2B, it is connectable with personal digital assistant 3AB from both base transceiver station 1A and base transceiver station 1B. For this reason, although two or more sets of base transceiver stations may be detected as a base transceiver station connectable with a personal digital assistant with the conventional configuration, it was not able to be specified whether a personal digital assistant is the closest to which base transceiver station.

[0007] The purpose of this invention is to offer how the location of a personal digital assistant is detectable with high precision in microcell radio system.

[0008]

[Means for Solving the Problem] By comparing the received-data signal received in a personal digital assistant in a sequential call, a transmit data signal, and a base transceiver station through two or more base transceiver stations, and measuring and memorizing a transmission-and-reception time delay, this invention computes the distance from the propagation delay time between two or more connectable base transceiver stations, a base transceiver station, and a personal digital assistant, and carries out location detection of a personal digital assistant.

[0009]

[Embodiment of the Invention] The system configuration which applied the 1st example of this invention is shown in drawing 1 , and the same sign is attached to drawing 5 and a corresponding part. Base transceiver stations 1A and 1B are constituted by a transmitter 11, a receiver 12, a modulator 13, a demodulator 14, the baseband circuit 15, and the propagation-delay-time measuring circuit 21, respectively. 3 is a personal digital assistant, and transmits and receives commo data by the base transceiver station and the wireless circuit.

[0010] When base transceiver station 1A to personal digital assistant 3A is called as an example and there is a response, it detects with that to which personal digital assistant 3A is located in wireless zone 2of base transceiver station 1A A. In that case, the propagation-delay-time measuring circuit 21 of base transceiver station 1A compares the received data which it was transmitted from transmit data and personal digital assistant 3A, and were received, and measures the propagation delay time of personal digital assistant 3A and base transceiver station 1A. A store circuit 22 carries out number management of two or more base transceiver station and two or more personal digital assistants, and memorizes the propagation delay time of a base transceiver station number connectable with a personal digital assistant, and the personal digital assistant under message. In consideration of the distance equivalent to propagation delay time, it calculates and asks for the location of a personal digital assistant in an arithmetic circuit 23 from the location corresponding to the management number of the base transceiver station written in the store circuit 22.

[0011] Drawing 2 is the explanatory view of the frame structure in the case of PHS which measures propagation delay time. PHS is the four-channel TDMA-TDD method of transmitting 4 time slots TX1-TX4 and receiving 4 time slots RX1-RX4, and TDMA frame length is 5ms. The transmitting burst 1, for example, TX, and the reception burst RX 1 which has a transmission-



and-reception time delay for 2.5ms from the transmitting burst TX1 are used for the communication link with one personal digital assistant. The transmitting burst TX1 of a base transceiver station is received, and you detect the timing of the TDMA frame, make it delayed by the personal digital assistant for 2.5ms, and it transmits by the time slot of RX1 towards a base transceiver station. In a base transceiver station, the time delay difference of the transmitting burst TX1 and the reception burst RX 1 is delayed for 2.5ms a gone part of the propagation delay time of a transmission-and-reception time delay, a base transceiver station, and a personal digital assistant. For this reason, propagation delay time can be measured by comparing the data of the transceiver bursts TX1 and RX1. TX2-TX4, and RX2-RX4 are transceiver time slots used with another personal digital assistant.

[0012] Drawing 3 shows the frame structure of the slot for a message of PHS, and comes the lamp time R for transient responses first from the start symbol SS, PURIAMPURU PR, synchronous WORD (unique WORD) UW, information bit I, and error detecting code CRC. If contained in a transmitted and received data, propagation delay time can be measured by carrying out the coincidence comparison of the unique WORD pattern UW, detecting a unique WORD location, and measuring a transmission-and-reception time delay.

[0013] Drawing 4 shows the 2nd example of this invention, and has attached the same sign to drawing 1 and a corresponding part. Base transceiver station 1A consists of a transmitter 31, a receiver 32, a photoelectricity (O/E) converter 41, and an electric light (E/O) converter 42, it connects with the centralized-control station 20 with an optical fiber, and the centralized-control station 20 consists of a modulator 33, a demodulator 34, the baseband processing circuit 35, the delay measuring instrument 21 which measures propagation delay time and the photoelectricity (O/E) converter 41, and an electric light (E/O) converter 42. Since time delay measurement can be performed in a centralized-control office, it differs from the 1st example that the control line which transmits a delay data signal between a base transceiver station and a store circuit 22 is unnecessary.

[0014]

[Effect of the Invention] As explained above, by comparing with transmit data the received data which perform a sequential call communication link and are received in a personal digital assistant in a base transceiver station through two or more base transceiver stations, this invention can measure propagation delay time, can measure the distance from two or more connectable base transceiver stations, and can carry out location detection of the location of a personal digital assistant with high precision.

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[Translation done.]

## TECHNICAL FIELD

[Field of the Invention] This invention relates to the approach of detecting the location of the personal digital assistant in the mobile communication of microcell radio system.

[Translation done.]



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## PRIOR ART

[Description of the Prior Art] Drawing 5 shows the structure of a system which performs the conventional method of detecting the location of a personal digital assistant in the migration communication system which used microcell radio system. In order for a microcell method to be a method which repeats the same frequency and uses a wireless zone (cel) radius as about several 100m for a frequency deployment and for a base transceiver station to carry out a line connection to a personal digital assistant, the distance with a personal digital assistant needs to be less than about several 100m, and when a personal digital assistant comes out of a wireless zone (cel), it must connect using the base transceiver station of a migration place wireless zone (cel). For this reason, the location of a personal digital assistant is detectable by getting to know the installation location of the base transceiver station connected by carrying out a line connection to a personal digital assistant.

[0003] In drawing 5 , base transceiver station 1A performs the communication link between personal digital assistant 3A located in self-wireless zone 2A, and performs transmission and reception of voice data and control data by transmitting and receiving a wireless electric wave. The interface circuitry 5 in a contact 4 makes connection between a public network 6 and the wireless line control circuit 7, and a public network 6 is connected with a personal digital assistant 3 by the call origination from a personal digital assistant 3, the wireless line control circuit 7 calls a personal digital assistant 3 by the call in from a public network 6, and it connects it. When a personal digital assistant 3 is called, an electric wave reaches a personal digital assistant 3 and the call control circuit 8 has a response by using two or more base transceiver station 1A and 1B— one by one every fixed time amount, it detects that a personal digital assistant 3 is located in the wireless zone 2 of the receiving base transceiver station 1. Memorizing this relation to a store circuit 9, a store circuit 9 carries out number management of two or more base transceiver station and two or more personal digital assistants, and memorizes a base transceiver station number connectable with a personal digital assistant. The wireless zone in which a personal digital assistant is located is displayed on a display circuit 10.

[0004] By drawing 5 , personal digital assistant 3A is located in wireless zone 2of base transceiver station 1A A, base transceiver station 1A is the distance which can be talked over the telephone, and base transceiver station 1B shows the case where a message is impossible. When base transceiver station 1A to personal digital assistant 3A is called and there is a response from personal digital assistant 3A, a store circuit 9 memorizes that personal digital assistant 3A is located in wireless zone (microcell) 2A in which base transceiver station 1A can connect with personal digital assistant 3A, and base transceiver station 1A is located. Next, when base transceiver station 1B to personal digital assistant 3A is called and there is no response, it memorizes that base transceiver station 1B was not able to connect the store circuit 9 with personal digital assistant 3A.

[0005] Next, personal digital assistant 3AB in drawing 5 is the case where it is located in base transceiver station 1A and both wireless zone 2A of base transceiver station 1B, and 2B, and base transceiver station 1A and base transceiver station 1B are located in personal digital assistant 3AB at the distance which can be talked over the telephone. In this case, it memorizes that base transceiver station 1A and base transceiver station 1B have connected the store

circuit 9 to personal digital assistant 3AB. Therefore, since whether it is close to which being located in one of the wireless zones of base transceiver station 1A and base transceiver station 1B although it is detectable was not able to specify personal digital assistant 3AB, exact location detection was not able to do it.

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[Translation done.]





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## EFFECT OF THE INVENTION

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[Effect of the Invention] As explained above, by comparing with transmit data the received data which perform a sequential call communication link and are received in a personal digital assistant in a base transceiver station through two or more base transceiver stations, this invention can measure propagation delay time, can measure the distance from two or more connectable base transceiver stations, and can carry out location detection of the location of a personal digital assistant with high precision.

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[Translation done.]

## TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In order to lose the blind zone of an electric wave, when the reception input of a personal digital assistant becomes weak around the wireless zone distant from the base transceiver station by making a wireless zone overlap and a line connection with a base transceiver station becomes impossible, it enables it to have connected with other base transceiver stations with microcell radio system generally. With the configuration of drawing 5 , since personal digital assistant 3AB is moving to the mid-position of wireless zone 2A and 2B, it is connectable with personal digital assistant 3AB from both base transceiver station 1A and base transceiver station 1B. For this reason, although two or more sets of base transceiver stations may be detected as a base transceiver station connectable with a personal digital assistant with the conventional configuration, it was not able to be specified whether a personal digital assistant is the closest to which base transceiver station.
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## MEANS

[Means for Solving the Problem] By comparing the received-data signal received in a personal digital assistant in a sequential call, a transmit data signal, and a base transceiver station through two or more base transceiver stations, and measuring and memorizing a transmission-and-reception time delay, this invention computes the distance from the propagation delay time between two or more connectable base transceiver stations, a base transceiver station, and a personal digital assistant, and carries out location detection of a personal digital assistant.
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[Embodiment of the Invention] The system configuration which applied the 1st example of this invention is shown in drawing 1 , and the same sign is attached to drawing 5 and a corresponding part. Base transceiver stations 1A and 1B are constituted by a transmitter 11, a receiver 12, a modulator 13, a demodulator 14, the baseband circuit 15, and the propagation-delay-time measuring circuit 21, respectively. 3 is a personal digital assistant, and transmits and receives commo data by the base transceiver station and the wireless circuit.
[0010] When base transceiver station 1A to personal digital assistant 3A is called as an example and there is a response, it detects with that to which personal digital assistant 3A is located in wireless zone 2of base transceiver station 1A A. In that case, the propagation-delay-time measuring circuit 21 of base transceiver station 1A compares the received data which it was transmitted from transmit data and personal digital assistant 3A, and were received, and measures the propagation delay time of personal digital assistant 3A and base transceiver station 1A. A store circuit 22 carries out number management of two or more base transceiver station and two or more personal digital assistants, and memorizes the propagation delay time of a base transceiver station number connectable with a personal digital assistant, and the personal digital assistant under message. In consideration of the distance equivalent to propagation delay time, it calculates and asks for the location of a personal digital assistant in an arithmetic circuit 23 from the location corresponding to the management number of the base transceiver station written in the store circuit 22.
[0011] Drawing 2 is the explanatory view of the frame structure in the case of PHS which measures propagation delay time. PHS is the four-channel TDMA-TDD method of transmitting 4 time slots TX1-TX4 and receiving 4 time slots RX1-RX4, and TDMA frame length is 5ms. The transmitting burst 1, for example, TX, and the reception burst RX 1 which has a transmission-and-reception time delay for 2.5ms from the transmitting burst TX1 are used for the communication link with one personal digital assistant. The transmitting burst TX1 of a base transceiver station is received, and you detect the timing of the TDMA frame, make it delayed by the personal digital assistant for 2.5ms, and it transmits by the time slot of RX1 towards a base transceiver station. In a base transceiver station, the time delay difference of the transmitting burst TX1 and the reception burst RX 1 is delayed for 2.5ms a gone part of the propagation delay time of a transmission-and-reception time delay, a base transceiver station, and a personal digital assistant. For this reason, propagation delay time can be measured by comparing the data of the transceiver bursts TX1 and RX1. TX2-TX4, and RX2-RX4 are transceiver time slots used with another personal digital assistant.
[0012] Drawing 3 shows the frame structure of the slot for a message of PHS, and comes the

lamp time R for transient responses first from the start symbol SS, PURIAMPURU PR, synchronous WORD (unique WORD) UW, information bit I, and error detecting code CRC. If contained in a transmitted and received data, propagation delay time can be measured by carrying out the coincidence comparison of the unique WORD pattern UW, detecting a unique WORD location, and measuring a transmission-and-reception time delay.

[0013] Drawing 4 shows the 2nd example of this invention, and has attached the same sign to drawing 1 and a corresponding part. Base transceiver station 1A consists of a transmitter 31, a receiver 32, a photoelectricity (O/E) converter 41, and an electric light (E/O) converter 42, it connects with the centralized-control station 20 with an optical fiber, and the centralized-control station 20 consists of a modulator 33, a demodulator 34, the baseband processing circuit 35, the delay measuring instrument 21 which measures propagation delay time and the photoelectricity (O/E) converter 41, and an electric light (E/O) converter 42. Since time delay measurement can be performed in a centralized-control office, it differs from the 1st example that the control line which transmits a delay data signal between a base transceiver station and a store circuit 22 is unnecessary.

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[Translation done.]





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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The block diagram showing the system configuration to which the 1st example of this invention is applied.

[Drawing 2] Drawing explaining a TDMA frame structure.

[Drawing 3] Drawing showing the configuration of one slot of TDMA.

[Drawing 4] The block diagram showing the structure of a system to which the 2nd example of this invention is applied.

[Drawing 5] The block diagram showing the structure of a system to which the conventional personal digital assistant location detection approach is applied.

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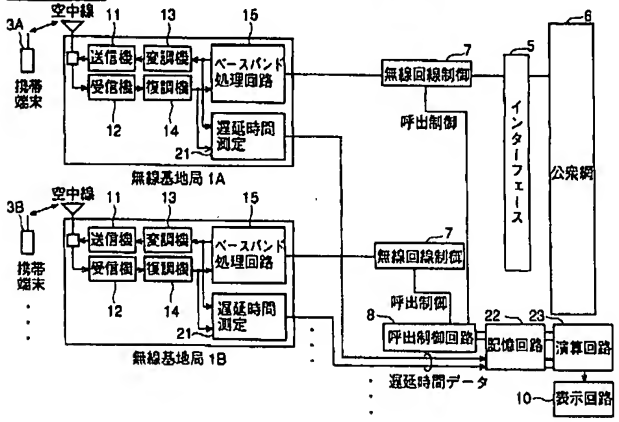
[Translation done.]

## DRAWINGS

[Drawing 1]

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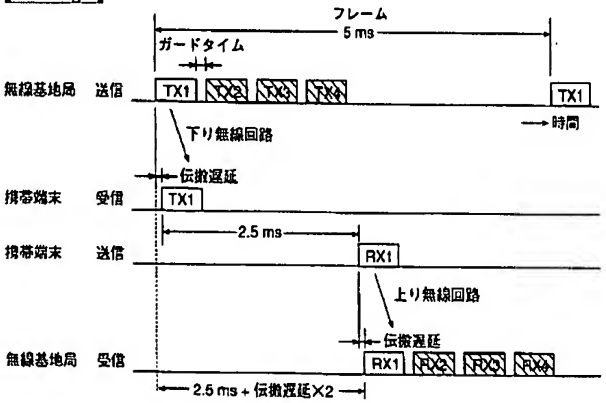
[Drawing 2]

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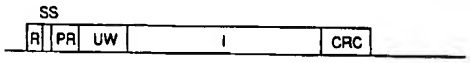
[Drawing 3]

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[Drawing 4]

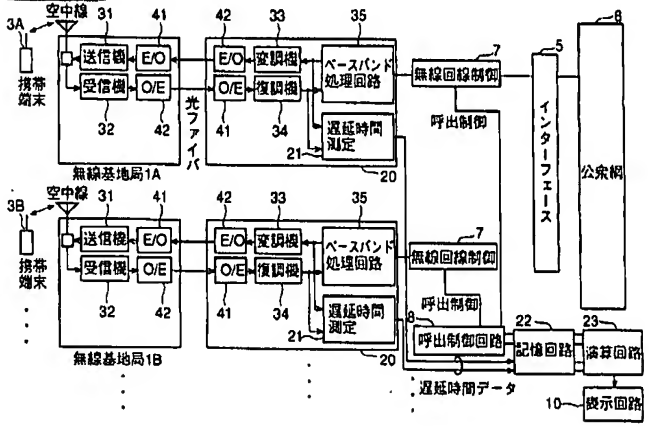


図 4

[Drawing 5]

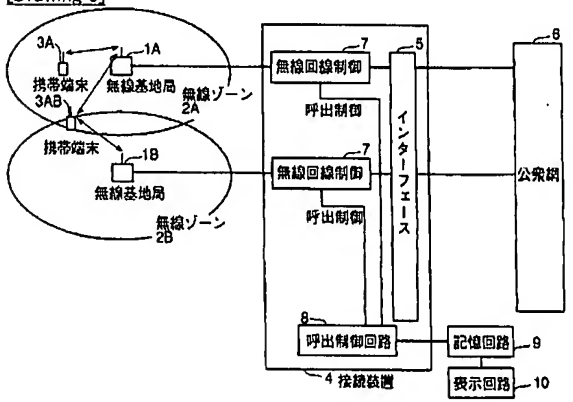


図 5

[Translation done.]